A11 wherein first contact holes penetrating the interlayer insulating film to reach the electrode pad and second contact holes penetrating the interlayer insulating film and the second capacitance insulating film to reach the second active region are provided, and

a diameter of the second contact hole is larger than that of the first contact hole.

A12 6. (Amended) The semiconductor device according to claim 4,

wherein an aspect ratio of the first contact hole is equal to that of the second contact hole.

Please add new claim 16 as follows:

A13 --16. The semiconductor device according to claim 1,

wherein the widths of the lead conductive films are substantially constant.--

REMARKS

The Examiner's Office Action of October 31, 2002 has been received and its contents reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application.

Claims 1-6 were pending prior to this amendment for consideration, as claims 7-15 have been withdrawn by the Election filed August 1, 2002. By this Amendment claims 1, 4 and 6 have been amended, claim 5 has been cancelled, and a new claim 16 has been added. Accordingly, claims 1-4, 6, and 16 are pending for consideration in the present application, of which claims 1, 3, and 4 are independent. In view of the actions above and the remarks below, reconsideration and allowance of the pending claims are respectfully requested.

Before turning to the detailed Office Action, Applicants note that a substitute Fig. 5A is filed herewith to amend the typographical error, specifically "52" to "51". Additionally, a substitute Fig. 1 is filed herewith, along with amendments to pages 6, 16, 18, 20, 22-25, 27, containing matter based on Figs. 2A and 3A.

Referring now to the detailed Office Action, claims 1 and 2 are rejected under 35 U.S.C. §112, first paragraph, as containing subject matter which was not described in the specification in such way as to enable one skilled in the art to which it pertains to make and/or use the invention. More specifically, the Examiner asserts that in independent claim 1 and in the

specification, there is no recitation of how to determine "w" within a distance, Rcr, at the boundary. Further, in dependent claim 2, there is ambiguity with respect to a value for S/L.

Further, claim 1 is rejected under 35 U.S.C. §112, second paragraph, as indefinite. Particularly, claim 1 includes the phrase "certain value or less", which is deemed by the Examiner as indefinite. In response, Applicants have amended claim 1, as shown above, to delete the phrase "certain value or less" and to further recite "a ratio of a total sum of exposed areas of the electrode pad in the contact holes, with respect to a total sum of widths of the lead conductive films on the boundary line between the active region and the isolating region, is small enough so that a breakdown ratio of the capacitance insulating film will have no practical problem."

The amendments of "a capacitance insulating film that is provided on the active region and in contact with the isolating region" and "a total sum of widths of the lead conductive films on the boundary line between the active region and the isolating region" in the amended claim 1 are for the clarification of the present invention based on, e.g., Figs. 2A and 3A. Further, the amendment of "small enough so that breakdown ratio of the capacitance insulating film will have no practical problem" is supported by, e.g., page 22, lines 5-7 of the present specification.

Accordingly, as the language of claim 1 is clarified by the above-discussed amendment, reconsideration and withdrawal of the §112, first paragraph and second paragraph, rejections of claims 1 and 2 is respectfully requested.

Claims 1, 3-6 is rejected under 35 U.S.C. §102(b) as anticipated by Saito et al. (U.S. Patent No. 5,961,556 – hereafter Saito). It is noted that the rejection under 35 U.S.C. §103(a) of claims 3-6 in Section 8, page 4 of the Office action appear to be a typographical error. Accordingly, Applicants are interpreting the §103(a) rejection as a §102(b) rejection.

According to the amended claim 1 of the present invention, the ratio of the total sum of exposed areas of the electrode pad in the contact holes, with respect to the total sum of widths of the lead conductive films on the boundary line between the active region and the isolating region, is small enough so that the breakdown ratio of the capacitance insulating film will have no practical problem. However, Saito fails to disclose these features.

According to claim 3 of the present invention, the capacitance insulating film is formed on the active region and has a boundary portion in contact with the isolating region, and the

capacitance insulating film has a larger thickness in the boundary portion than in other portions. However, Saito also fails disclose these features.

In the rejection of claim 3, the Examiner appears to assert that Applicants' claimed feature of the capacitance insulating film being thicker within the boundary portion than in other portions as the LOCOS oxide film 17 of Saito. However, it is well known that a LOCOS oxide film is formed by LOCOS method, which is used to form an isolating region, and it is also well known that the thickness of the end portions are smaller than that of the center portion. In other words, Applicants respectfully assert that the LOCOS oxide film 17 of Saito corresponds to the isolating region of claim 3 and is not a capacitance insulating film.

Hence, Saito merely teaches a capacitance insulating film having a substantially constant thickness, and fails to disclose that the capacitance insulating film has a larger thickness in the boundary portion than in other portions.

According to amended claim 4, the first contact holes penetrating the interlayer insulating film to reach the electrode pad and second contact holes penetrating the interlayer insulating film and the second capacitance insulating film to reach the second active region are provided, and a diameter of the second contact hole is larger than that of the first contact hole. However, Saito also fails to disclose these features.

The Examiner asserts that, as shown in Fig. 1 of Saito, the diameter of the contact 13, which corresponds to the second contact hole of the amended claim 4, is larger than the diameter of the contact 14, which corresponds to the first contact hole of the amended claim 4. However, after measuring the sizes of the two contacts in Fig. 1 of Saito, it is obvious that the contact 14 is larger than the contact 13, as the contact 13 is 2 mm and the contact 14 (first contact hole) is 3 mm.

Further, referring to Fig. 2 of Saito, which shows a planar diagram of the capacitor part in Fig. 1, 13 is larger than 14. However, as described in column 9, lines 47-48 of Saito, 13 a metallization line but 14 is a clock electrode CK, which is an electrode and not a contact. The contact connecting to the electrode pad and the active region is actually provided below 13 and 14. In other words, Saito fails to disclose the diameter of the contact. Hence, Saito fails to disclose Applicants' claimed feature wherein a diameter of the second contact hole is larger than

that of the first contact hole recited in amended claim 4. Support for the amendment of claim 4 is found at least in, e.g., canceled claim 5.

Claim 6 has been amended to change its dependency from canceled claim 5 to claim 4. Accordingly, the amendment of claim 4 and the arguments related to the rejection of claim 4 are also applicable to the rejection of claim 6.

Consequently, since each and every feature of the present claims is not taught (and is not inherent) in the teachings of Saito, as is required by MPEP Chapter 2131 in order to establish anticipation, the rejection of claims 1-6, under 35 U.S.C. § 102(b), as anticipated by Saito would be improper.

New claim 16 has been added to further complete the scope of the invention to which Applicants are entitled. Support for new claim 16 is based on Figs. 2A and 3A. As shown in Figs. 2A and 3A, the widths of the lead conductive films 22 are all constant. Hence, no new matter is added.

In view of the amendments and arguments set forth above, Applicants respectfully request reconsideration and withdrawal of all the pending rejections.

Having responded to all rejections set forth in the outstanding non-Final Office Action, it is submitted that claims 1-4, and 6 and new claim 16 are now in condition for allowance. An early and favorable Notice of Allowance is respectfully solicited. In the event that the Examiner is of the opinion that a brief telephone or personal interview will facilitate allowance of one or more of the above claims, the Examiner is courteously requested to contact Applicants' undersigned representative.

Respectfully submitted,

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MARK-UP VERSION OF AMENDMENTS

In the Specification:

Please amend Page 6, second paragraph as follows:

A semiconductor device of the present invention includes a semiconductor substrate including an active region and an isolating region provided so as to enclose the active region; a capacitance insulating film that is provided on the active region and [has a boundary portion] in contact with the isolating region; an upper electrode provided on the capacitance insulating film so as to be spaced away from the isolating region; an electrode pad provided on the isolating region; a lead conductive film provided over a part of the capacitance insulating film and a part of the isolating region for connecting the upper electrode and the electrode pad; and an interlayer insulating film provided over the substrate, wherein contact holes penetrating the interlayer insulating film to reach the electrode pad are formed, and the ratio of the total sum of the exposed areas of the electrode pad in the contact holes with respect to the total sum of the widths of the lead conductive films [in] on the boundary [portion] line between the active region and the isolating region is a certain value or less.

Please amend Page 16, second paragraph as follows:

Figure 1 is a graph showing the relationship between the ratio (S/L) of the total sum (S) of the exposed areas of an electrode pad in contact holes to the total sum (L) of the widths (w) of lead conductive films [in] on a boundary [portion of a capacitance insulating film that is in contact with] line between an active region and an isolating region and the breakdown ratio of the capacitance insulating film.

Please amend Page 18, the paragraph which extends to page 19 as follows:

Figure 1 is a graph plotted with the breakdown ratio of the capacitance insulting film 118 with respect to the ratio (S/L) of the total sum (S) of the exposed areas of the electrode pad 124

in contact holes 128 to the total sum (L) of the widths (w) of the lead conductive films 122 [in] on the boundary [portion Rcr of the capacitance insulating film 118 that is in contact with] line between the active region 116 and the isolating region 114. Herein, increasing or decreasing the S/L was performed by setting L as a constant (8 μm) and increasing or decreasing S. Increasing or decreasing S was performed in the following two ways: The diameter of the contact hole 128 is set to be a convention al value (0.28 μm) and the number of the contact holes 128 is increased or decreased; and the diameter of the contact ho9le 128 is set to be smaller (0.18 μm) than the conventional value and the number of the contact holes 128 is increased or decreased. The measurement conductions shown in Table 1 are those in the case where the diameter of the contact hole 128 is set to be a conventional value (0.28 μm) and the number of the contact holes 128 is increasd or decreased. The results indicate that when the value of S/L is 4 or less, the breakdown ratio of the capacitance insulating film 118 is substantially zero, as shown in Figure 1. Embodiments 1 to 3 below were performed based on these results.

Please amend page 20, first paragraph as follows:

In the semiconductor device 10 of this embodiment, based on the results of Figure 1, the value of S/L is adjusted to 4 or less by reducing the number of the cont6act holes 28 (a diameter of 0.28 μm). Thus, the ratio (S/L) of the total sum (S) of the exposed areas of the electrode pad 24 in the contact holes 28 with respect to the total sum (which is equal to the total sum of the widths of the lead conductive films 22 in this embodiment: L) of the widths (w) of the lead conductive films 22 [in] on the boundary [region Rcr of the capacitance insulating film 18 that is in contact with] line between the active region and the isolating region 14 is reduced. As a result, the breakdown ratio of the capacitance insulating film 18 can be substantially zero by adjusting the value of S/L to 4 or less, as shown in Figure 1.

Please amend page 21, last paragraph which ends on page 22:

In this embodiment, the capacitance insulating film 18 formed of a silicon oxynitride film was used, but the capacitance insulating film 18 can be formed of a silicon oxide film, a silicon nitride film or other high dielectric constant films. However, the capacitor insulating films 18

formed of these material shave a different breakdown voltage from that of a silicon oxide film, so that the value of S/L that allows the breakdown ratio of the capacitance insulating film 18 to be substantially zero can be varied depending on the material of the capacitance insulating film 18. However, the value of S/L is still important, regardless of the material used. Therefore, the value of S/L that allows the breakdown ratio to be substantially zero or small enough so that there is no practical problem is determined, and based on the results, the widths (w) of the lead conductive films 22 [in] on the boundary [portion Rcr] line between the active region 16 and the isolating region 14 and the diameter and the number of the contact holes 28 can be adjusted.

Please amend page 22, last paragraph which ends on page 23:

In this embodiment, based on the results of Figure 1, the diameter of the contact hole 28 is smaller than that of the conventional semiconductor device. Thus, in the semiconductor device 20 of this embodiment, the ratio (S/L) of the total sum (S) of the exposed areas of the electrode pad 24 in the contact hole 28 with respect to the total sum (L) of the widths (w) of the lead conductive films 22 [in] on the boundary [region Rcr] line between the active region 16 and the isolating region 14 is set to 4 or less. As a result, the breakdown ratio of the capacitance insulating film 18 can be substantially zero, as shown in Figure 1.

Please amend page 24, first paragraph as follows:

Furthermore, in this embodiment, the capacitance insulating film 18 formed of a silicon oxynitride film was used, as in Embodiment 1. However, the capacitance insulating film 18 can be formed of a silicon oxide film a silicon nitride film or other high dielectric constant films. Furthermore, the value of S/L that allows the breakdown ratio of the capacitance insulating film 18 to be substantially zero can be varied depending on the material of the capacitance insulating film 18. However, the value of S/L is still important, regardless of the material used. Therefore, the value of S/L that allows the breakdown ratio to be substantially zero or small enough so that there is no practical problem is determined, and based on the results, the widths (w) of the lead

conductive films 22 [in] on the boundary [portion Rcr] line between the active region 16 and the isolating region 14 and the diameter and the number of the contact holes 28, can be adjusted.

Please amend page 25, second paragraph as follows:

In Embodiments 1 and 2, the total sum (L) of the widths (w) of the lead conductive films 22 [in] on the boundary [portion Rcr] line between the active region 16 and the isolating region 14 is 8 μm, and it is preferable that L is 8 μm or more because the electric field in the boundary portion Rcr can be relaxed. The number of the contact holes 28 is 158 in Embodiment 1 and 260 in Embodiment 2, and it is preferable that the number of the contact holes 28 is not more than 522. The exposed area of the electrode pad 24 in the contact holes 28 is 9.7 μm^2 in Embodiment 1 and 16 μm^2 in Embodiment 2, and it is preferable that the exposed area is not more than 32 μm^2 because the amount of charges accumulated in the electrode pad can be reduced.

Please amend page 27 as follows:

The oxidation speed of silicon is increased on a region containing boron having an oxidation enhanced diffusion effect such as the high-concentration boron region 29. Therefore, when forming the capacitance insulating film 18 on the active region 16, the thickness of the boundary portion Rcr of the capacitance insulating film 18 that is in contact with the isolating region 14 is large. In order words, the capacitance insulating film 18 having portions with different thicknesses can be formed in one process. Thus, the breakdown voltage of the boundary portion Rcr of the capacitance insulating film 18 that is in contact with the isolating region 14 can be increased. For example, in the case of this embodiment, the thickness of the capacitance insulating film 18 on the active region is 4 nm, whereas the thickness of the boundary portion Rcr of the capacitance insulating film 18 that is in contact with the isolating region 14 is 8 nm. For this reason, the breakdown voltage of the boundary portion Rcr of the capacitance insulating film 18 that is in contact with the isolating region 14 is about twice the breakdown voltage of the capacitance insulating film 18 on the active region 16, and the breakdown of the capacitance insulating film 18 did not occur until the value of S/L reached

about 8. This indicates that according to this embodiment, the ratio of the total sum (S) of the exposed areas of the electrode pad 24 in the contact holes 28 with respect to the total sum (L) of the widths (w) of the lead conductive films 22 [in] on the boundary [portion Rcr] line between the active region 16 and the isolating region 14 can be increase.

In the Claims:

Please amend claims 1, 4 and 6 as follows:

1. (Amended) A semiconductor device comprising:

a semiconductor substrate including an active region and an isolating region provided so as to enclose the active region;

a capacitance insulating film that is provided on the active region and [has a boundary portion] in contact with the isolating region;

an upper electrode provided on the capacitance insulating film so as to be spaced away from the isolating region;

an electrode pad provided on the isolating region;

a lead conductive film provided over a part of the capacitance insulating film and a part of the isolating region for connecting the upper electrode and the electrode pad; and

an interlayer insulating film provided over the substrate,

wherein contact holes penetrating the interlayer insulating film to reach the electrode pad are formed, and

a ratio of a total sum of exposed areas of the electrode pad in the contact holes, with respect to a total sum of widths of the lead conductive films [in] on the boundary [portion is a certain value or less] line between the active region and the isolating region, is small enough so that a breakdown ratio of the capacitance insulating film will have no practical problem.

4. (Amended) A semiconductor device comprising:

a semiconductor substrate including a first active region an isolating region formed so as to enclose the first active region, and a second active region provided such that the isolating region is sandwiched by the second active region and the first active region;

a first capacitance insulating film that is formed on the first active region and has a boundary portion in contact with the isolating region;

a second capacitance insulating film formed on the second active region;

an upper electrode provided on the first capacitance insulting film so as to be spaced away from the isolating region;

an electrode pad formed on the isolating region;

a lead conductive film provided over a part of the first capacitance insulating film and a part of the isolating region for connecting the upper electrode and the electrode pad; and

an interlayer insulating film provided over the substrate,

wherein first contact holes penetrating the interlayer insulating film to reach the electrode pad and second contact holes penetrating the interlayer insulating film and the second capacitance insulating film to reach the second active region are provided, and

a diameter of the second contact hole is larger than that of the first contact hole.

6. (Amended) The semiconductor device according to claim [5] 4,

wherein an aspect ratio of the first contact hole is equal to that of the second contact hole.